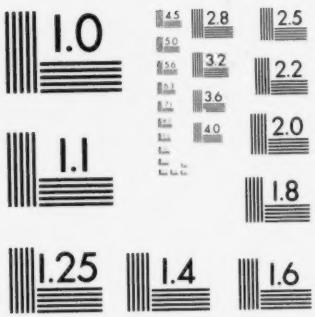

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

ALBERTA AIR EMISSION STANDARDS FOR ELECTRICITY GENERATION AND ALBERTA AIR EMISSION GUIDELINES FOR ELECTRICITY GENERATION

Alberta Environment

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Alberta Air Emission Standards For Electricity Generation

For the purposes of this Standard, the following definitions apply:

(a) "coal fired power plant" means a power plant that uses coal as its primary fuel;
(b) "BATEA" means best available technology economically achievable;
(c) "gas fired power plant" means a power plant that uses natural gas as its primary fuel;
(d) "cogeneration power plant" means a power plant that uses natural gas as its primary fuel and produces both steam that is used in an industrial process and thermal electric power;
(e) "electricity grid" means the interconnected electric system as defined in the Electricity Utilities Act;
(f) "generating unit" means a single line of process equipment that is directly related to the production of electricity at a power plant;
(g) "generating unit that has reached the end of its design life" means the generating units listed in Schedule 1, column 1 as of the dates enumerated in column 4;
(h) "new generating unit" means a generating unit that is commissioned on or after January 1, 2006 and that has not reached the end of its design life;
(i) "peaking unit" means a generating unit that has reached the end of its design life and which has been declared as a peaking unit pursuant to the terms of its approval;
(j) "transitional generating unit" means the generating units listed in Schedule 2, column 1;
(k) "power plant" means a power plant within the meaning of section 2(2)(vv) of the Activities Designation Regulation (AR 276/2003).

Section 1. New Generating Units of a Coal Fired Power Plant

1.1 Effective January 1, 2006, releases of the following substances into the atmosphere from any new generating unit of a coal fired power plant shall not exceed the limits specified in Table A.

Table A New Generating Units of a Coal Fired Power Plant Annual Emission Intensity Limits

Substance	Emission Source	Limit
Sulphur Dioxide (SO_2)	New generating unit	0.80 kg/MWh_{output} for each new generating unit
Nitrogen Oxides (NO_x)	New generating unit	0.69 kg/MWh_{output} for each new generating unit
Primary Particulate Matter (PM)	New generating unit	0.095 kg/MWh_{output} for each new generating unit

1.2 For purposes of 1.1, the MWh shall include the total net generation of electricity to the electricity grid and excludes any electricity used at the coal fired power plant.

Section 2. New Generating Units of a Natural Gas Fired or Cogeneration Power Plant

2..1 Effective January 1, 2006, releases of NO_x into the atmosphere from any new generating unit of a natural gas fired or cogeneration power plant shall not exceed the limits specified in Table B.

Table B New Generating Units of a Natural Gas Fired or Cogeneration Power Plant NO_x Annual Emission Intensity Limits

Electrical Generating Power Capacity of the Plant	Emission Source	Limit
0<20 MW	New generating unit	0.6 kg/MWh_{output} for each new generating unit
≥20-60 MW	New generating unit	0.4 kg/MWh_{output} for each new generating unit
>60 MW	New generating unit	0.3 kg/MWh_{output} for each new generating unit

2.2 For purposes of 2.1, the MWh shall include both the combined total thermal energy and the net generation of electricity excluding any electricity used to produce the electricity.

Section 3. Generating Units that have reached the end of their Design Life of a Coal Fired Power Plant

3.1 Effective January 1, 2006, releases of the following substances into the atmosphere from any generating unit that has reached the end of its design life of a coal fired power plant shall not exceed the limits specified in Table C.

Table C Generating Units of a Coal Fired Power Plant Post Design Life Annual Emission Intensity Limits

Substance	Emission Source	Limit
Sulphur Dioxide (SO_2)	Generating unit that has reached the end of its design life	0.80 kg/MWh_{output} for each generating unit
Nitrogen Oxides (NO_x)	Generating unit that has reached the end of its design life	0.69 kg/MWh_{output} for each generating unit

3.2 For purposes of 3.1, the MWh shall include the total net generation of electricity to the electricity grid and excludes any electricity used at the coal fired power plant.

Section 4. Transitional Generating Units of a Coal Fired Power Plant

4.1 Effective January 1, 2016, releases of the following substances into the atmosphere from any transitional generating unit of a coal fired power plant shall not exceed the limits specified in Table D.

Table D Transitional Generating Units of a Coal Fired Power Plant Annual Emission Intensity Limits

Substance	Emission Source	Limit
Sulphur Dioxide (SO_2)	Transitional generating unit	0.80 kg/MWh_{output} for each generating unit
Nitrogen Oxides (NO_x)	Transitional generating unit	0.69 kg/MWh_{output} for each generating unit

4.2 For purposes of 4.1, the MWh shall include the total net generation of electricity to the electricity grid and excludes any electricity used at the coal fired power plant.

Section 5. Generating Units that have reached the end of their Design Life of a Natural Gas Fired or Cogeneration Power Plant

5.1 Subject to section 5.3, effective January 1, 2006, releases of NOx into the atmosphere from any generating unit of a natural gas fired or cogeneration power plant that has reached the end of its design life shall not exceed the limits specified in Table E.

Table E Generating Units that have reached the end of their Design Life of a Natural Gas Fired or Cogeneration Power Plant NO_x Post Design Life Annual Emission Intensity Limits

Electrical Generating Power Capacity of the Plant	Emission Source	Limit
0<20 MW	Generating unit that has reached the end of its design life	0.6 kg/MWh_{output} for each generating unit

≥20-60 MW	Generating unit that has reached the end of its design life	0.4 kg/MWh_{output} for each generating unit
>60 MW	Generating unit that has reached the end of its design life	0.3 kg/MWh_{output} for each generating unit

5.2 For purposes of 5.1, the MWh shall include both the combined total thermal energy and the net generation of electricity excluding any electricity used to produce the electricity.

5.3 For generating units that have reached the end of their design life before January 1, 2010, the limits specified in 5.1 will be in effect on January 1, 2011.

Section 6. Peaking Units

6.1 Releases of NOx from a peaking unit into the atmosphere shall not exceed the following annual mass emission limit:

a) 1.008kg/MWh*maximum continuous rating in MW*1500 hours.

6.2 In addition to 6.1, a peaking unit shall not operate for less than 3 years from the date it became a peaking unit and not more than 60 years from the year of commissioning as set out in Schedule 1.

Schedule 1 – End of Design Life for Generating Units in the Province of Alberta

Major Generating Units of Coal Fired Power Plants

Unit	Year of commissioning	Year BATEA must be installed (by Dec. 31)	End of design life Year (by Dec. 31)
H.R. Milner	1972	2022	2012
Battle River 3	1969	2019	2013
Battle River 4	1975	2025	2015
Sundance 1	1970	2020	2017
Sundance 2	1973	2023	2017
Sundance 3	1976	2026	2020
Sundance 4	1977	2027	2020
Sundance 5	1978	2028	2020
Sundance 6	1980	2030	2020
Battle River 5	1981	2031	2021
Keephills 1	1983	2033	2023
Keephills 2	1984	2034	2024
Sheerness 1	1986	2036	2026
Genesee 2	1989	2039	2029
Sheerness 2	1990	2040	2030
Genesee 1	1994	2044	2034
Wabamun 1	1958	2010	N/A
Wabamun 2	1956	2010	N/A
Wabamun 3	1962	2010	N/A
Wabamun 4	1968	2010	N/A

Major Generating Units at Natural Gas Fired or Cogeneration Power Plants Larger than 100 MW

Unit	Year of commissioning	Year BATEA must be installed (by Dec. 31)[a]	End of Design life Year (by Dec. 31)
Muskeg River	2003	2043	2033
Joffre #1	2001	2041	2031
TransAlta/Air Liquide	1999	2039	2029
EnCana #1	2001	2041	2031
Nexen Inc #1	2001	2041	2031
Mahkeses Central Plant	2002	2042	2032
Suncor #1	2000	2040	2030
Syncrude #1	1999	2039	2029
Clover Bar #1	1970	2010	2010
Clover Bar #2	1973	2013	2010
Clover Bar #3	1977	2017	2010

Clover Bar #4	1979	2019	2010
ATCO/Shell Scotford (Upgrader)	2003	2043	2033
Calpine Energy Centre	2003	2043	2033
TCP PetroCan McKay River	2003	2043	2033
Hunt Power	2005	2045	2035
Opti Canada	2006	2046	2036
AES Merchant	2008	2048	2038
Opti Canada	2008	2048	2038
Syncrude	1978	2018	2008

[a] units that declare themselves peaking units and operate below the recommended cap, may continue to operate for an additional 20 years, at which time BATEA must be installed.

Schedule 2 - Transitional Generating Units of a Coal Fired Power Plant

Unit	Year of commissioning	Year BATEA must be installed (by Dec. 31)	Year Limits Listed in Table D to be Applied (by end of Dec. 31)	End of Design life Year (by Dec. 31)
Genesee 3	2005	2055	2015	2045

Alberta Air Emission Guidelines for Electricity Generation

Introduction

The *Alberta Air Emission Standards for Electricity Generation* (the Standard) and this Guideline have been prepared based on the Clean Air Strategic Alliance's Electricity Project Team document entitled *"An Emissions Management Framework for the Alberta Electricity Sector – Report to Stakeholders – November 2003"*. Implementation of the framework will lead to, amongst other things, significant reductions over time of the release of sulphur dioxide, nitrogen oxides, and primary particulate matter from the electricity sector.

All new generating units of a power plant for the generation of thermal electric power or new generating units at a cogeneration power plant that produce both thermal energy that is used in an industrial process and to generate thermal electric power are required to install pollution control technologies that shall, at a minimum, achieve the emission limits set out in the Standard in addition to any limits specified in its Environmental Protection and Enhancement Act (EPEA) approval. Additionally, any existing generating units of a power plant that reaches the end of its design life must meet the emission limits set out in the Standard as specified within its EPEA approval.

If necessary, and if an adverse effect is anticipated, more stringent controls of emissions, beyond the emission standards listed in the Standard, may be specified by Alberta Environment or other regulatory agencies.

The emission standards listed in the Standard represent what is achievable through implementing BATEA (Best Available Technology Economically Achievable). BATEA refers to technology that can achieve superior emissions performance and that has been demonstrated to be economically feasible through successful commercial application across a range of locations and fuel types. BATEA is used to establish emission control expectations or limits and will be reviewed on a specified timeframe and modified as necessary.

Emission Standards – SO2, NOx, and Primary Particulate Matter – as set out in the *Alberta Air Emission Standards For Electricity Generation*

Generating Units of a Coal Fired Power Plant

For generating units of a coal fired power plant, the electricity amount (in MWh) is to be based on the net generation to the electricity grid and excludes any electricity used at the power plant. If steam or waste heat is utilized by the coal fired power plant, the combined total thermal energy is the difference between the energy content of the steam transferred from the coal fired power plant (at the point of commodity transfer) to the steam/waste

heat host and the return condensate line (at the point of commodity transfer). See Appendix A for more details.

These emission standards shall be used along with the maximum continuous rating of the installed equipment and any other relevant operational information about the installed generating unit to set hourly emission limits within the EPEA approval that is issued for the activity.

Generating Units at a Natural Gas Fired or Cogeneration Power Plant

For generating units of a natural gas fired or cogeneration power plant, the amount of energy (in MWh) includes both the combined total thermal energy and electricity. The electricity amount is to be the net generation of electricity excluding any electricity used to produce electricity at the natural gas fired or cogeneration power plant. The combined total thermal energy is the difference between the energy content of the steam transferred from the natural gas fired or cogeneration power plant (at the point of commodity transfer) to the steam/waste heat host and the return condensate line (at the point of commodity transfer), if applicable. See Appendix A for more details.

These emission standards shall be used along with the maximum continuous rating of the installed equipment and any other relevant operational information about the installed generating unit to set hourly emission limits within the EPEA approval that is issued for the activity.

Other Fuels

If other fuels beyond coal or natural gas are being considered for use (for example, bitumen, petroleum coke, diesel fuel oil, hydrogen, or biomass), consult with Alberta Environment's Regional Approvals staff for guidance. Emission limits would be set through the EPEA approval process.

Emission Limits

For new generating units or newly installed equipment, the emission limits for primary particulate matter shall be based on a one-hour average or as otherwise specified in the EPEA approval.

For new generating units or newly installed equipment, emission limits for sulphur dioxide (SO_2) and nitrogen oxides (expressed as NO_2) shall be set as tonnes per hour based on a 720- hour rolling average and also as annual emission intensity limits.

For those generating units that have reached the end of their design life, the annual emission intensity limit shall be used to set an annual mass emission limit in addition to

the hourly emission limits within the approval. The need for any additional emission limits or basing the limits on different averaging periods would be made during the approval issuance phase and in consultation with Regional Approvals staff.

Source and Ambient Monitoring

For generating units of a coal fired power plant, continuous emission monitoring shall be required on the stack for sulphur dioxide (SO_2), nitrogen oxides (NO_x), stack effluent velocity or flow rate, and in-stack opacity in the effluent stream along with any other parameters necessary to determine mass emissions. For natural gas fired or cogeneration power plants, continuous emission monitoring shall be required on the stack for nitrogen oxides (NO_x) and stack effluent velocity or flow rate in the effluent stream along with any other parameters necessary to determine mass emissions. If the natural gas contains sulphur compounds, continuous emission monitoring for SO_2 may be required.

These technical requirements, along with performance specifications and use of equivalent methodologies such as predictive emission monitoring systems are outlined in the *Alberta Continuous Emission Monitoring System (CEMS) Code*. Any additional continuous emission monitoring parameters or contaminants **or** manual stack surveys will be determined during the approval issuance phase and in consultation with Alberta Environment's Regional Approvals staff.

Also, ambient air monitoring in the vicinity of the power plant may additionally be required. These requirements would be determined in consultation with Regional Approvals staff.

Review of Standards

Pursuant to the Electricity Project Team's report and recommendations, the standards for NO_x, SO_2, primary particulate matter, and mercury shall be subject to review on a set five-year cycle. The next review period will start no later than April 1, 2008 and will be completed no later than March 31, 2009. The effective date of the revised Standard would be January 1, 2011 as specified in the report and recommendations. This allows a proponent enough time to incorporate the new emission standards into any new project being contemplated.

Environmental Policy Branch
December 2005

Appendix A – Calculation of Combined Total Thermal Energy Used During Cogeneration

Combined total thermal energy (in MWh) used within a natural gas fired or cogeneration power plant is calculated based on the difference of the enthalpy of the steam leaving the heat recovery steam generator (HRSG) multiplied by its mass flow rate subtracting the enthalpy of the condensate (hot water) multiplied by its mass flow rate. These values would be aggregated over the time period of interest. In this regard, measurements of steam temperature, pressure, and flow rate are needed along with water temperature and flow rate.

The actual calculation is seen below:

$$EnergyUsed = \sum_{i=1}^{n}[h(steam)_i \times M(steam)_i] - \sum_{i=1}^{n}[h(condensate)_i \times M(condensate)_i]$$

where $h(steam)_i$ = enthalpy of i streams of steam (in kJ/kg) to the steam host,
and $h(condensate)_i$ = enthalpy of i streams of condensate (in kJ/kg) being returned back to the HRSG,
and $M(steam)_i$ = mass flow rate of i streams of steam (in kg/s),
and $M(condensate)_i$ = mass flow rate of i streams of condensate (in kg/s),
and n = total number of streams (for steam term) and total number of condensate streams (for condensate term).

$$TotalAmountofEnergy = \frac{EnergyUsed \times AmountofGenerationTime}{3.6 \times 10^6 kJ / MWh}$$

where *Energy Used* = amount of energy (in kJ/s), and
Amount of Generation Time = time period when energy is being utilized (in seconds).